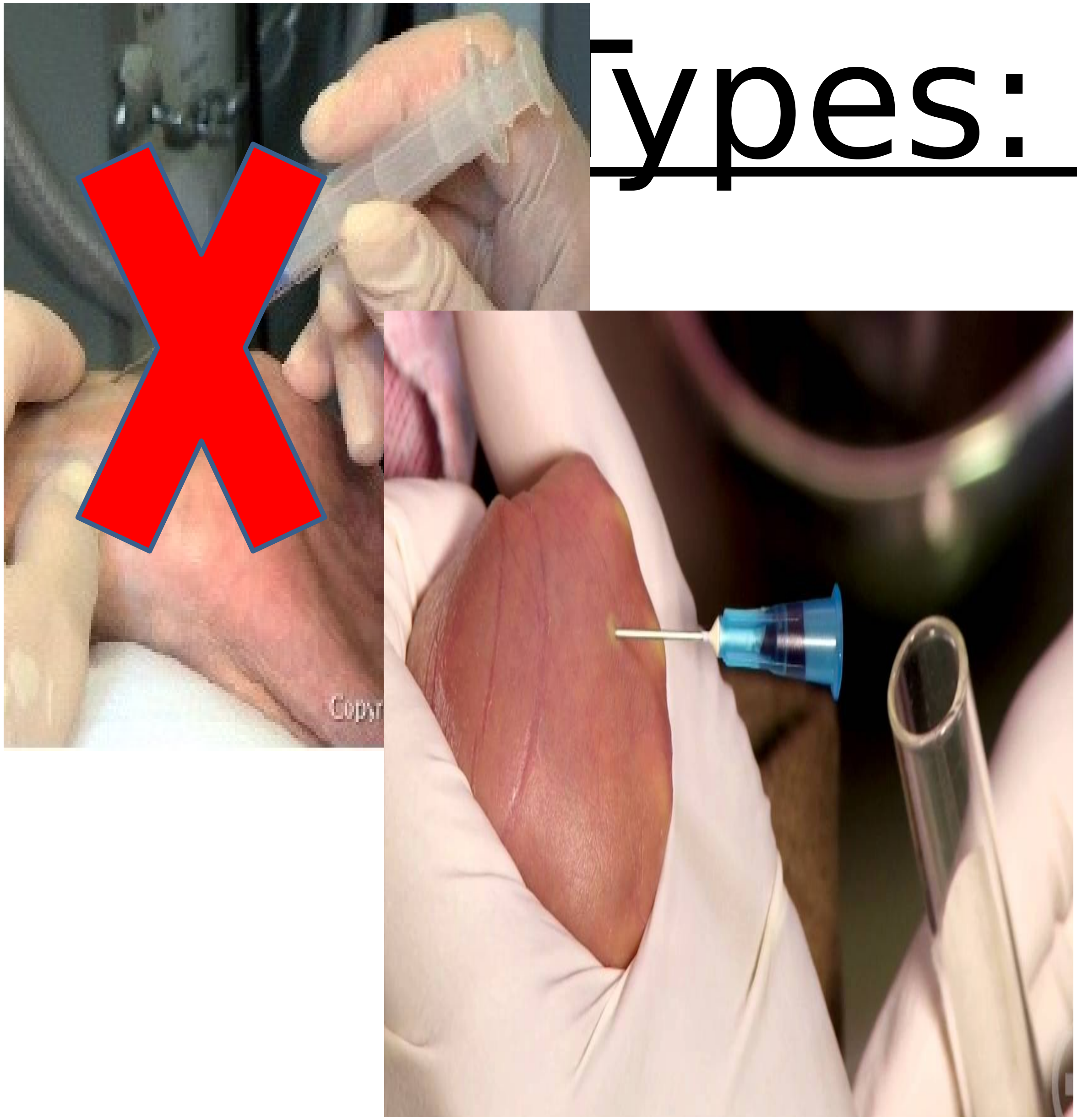
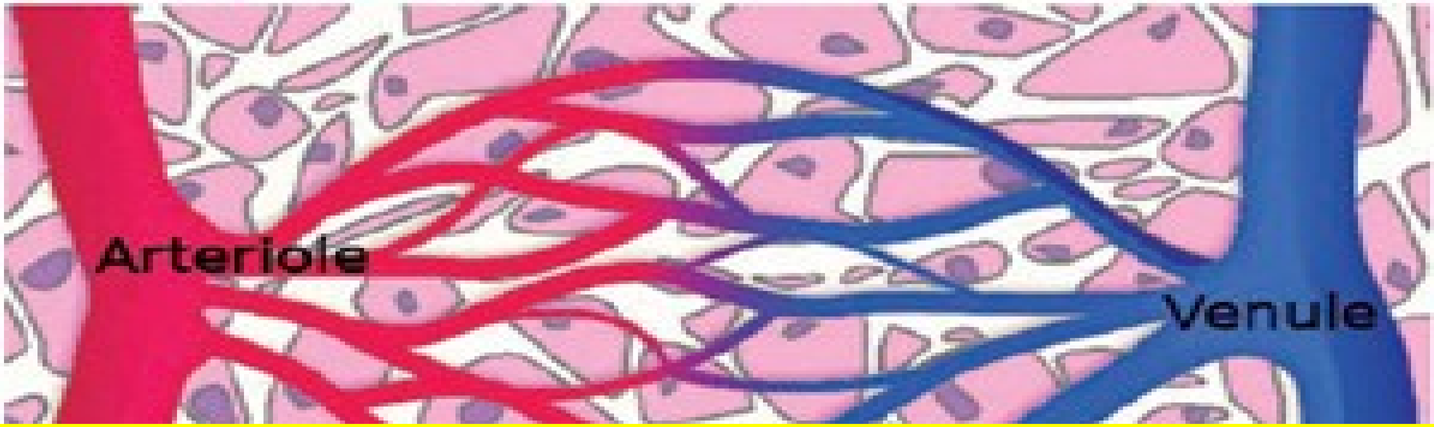
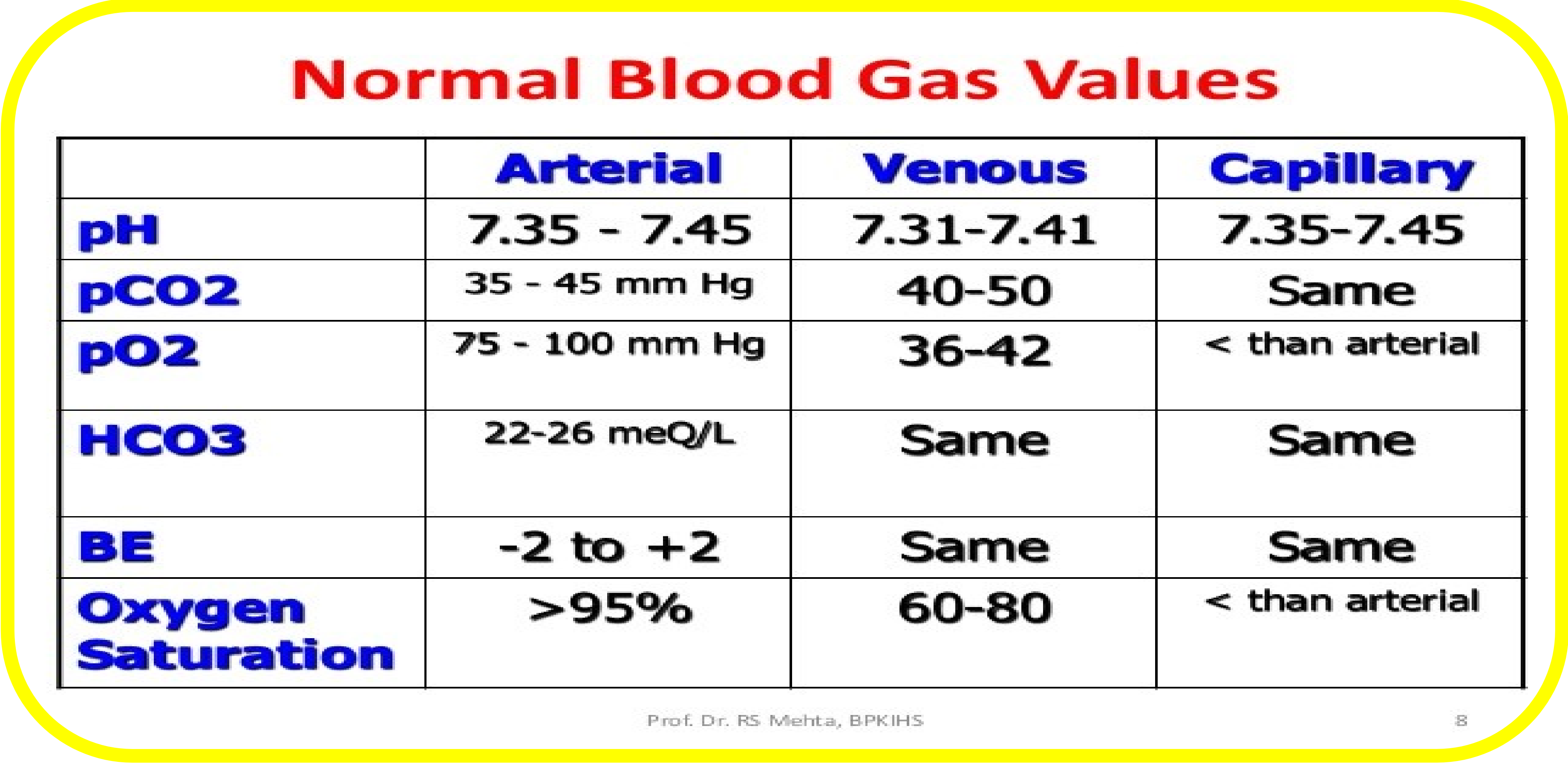
A(V)BG interpretation

Types:

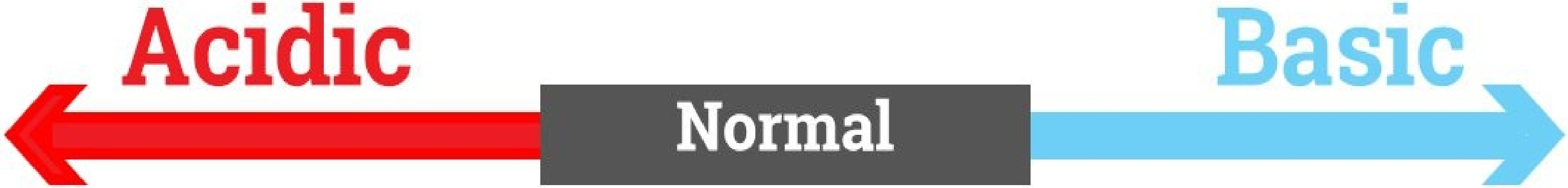






Normal Blood Gas Values

	Arterial	**Venous**	**Capillary**
pH	7.35 - 7.45	7.31-7.41	7.35-7.45
pCO2	35 - 45 mm Hg	40-50	Same
pO2	75 - 100 mm Hg	36-42	< than arterial
HCO3	22-26 meQ/L	Same	Same
BE	-2 to +2	Same	Same
Oxygen Saturation	>95%	60-80	< than arterial



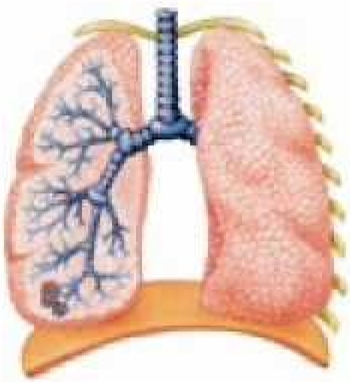
Acidic

Normal

Basic

7.35 - 7.45

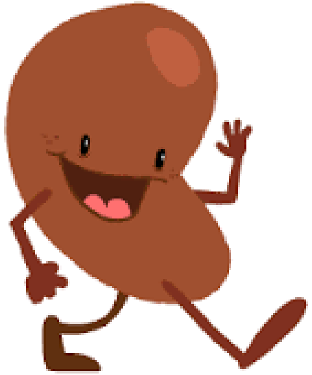
pH



45-35

$paCO_2$

(Respiratory)



22-26

HCO_3

(Metabolic)

Buffering systems

1

acts immediately.

2.Respiratory regulation of CO2

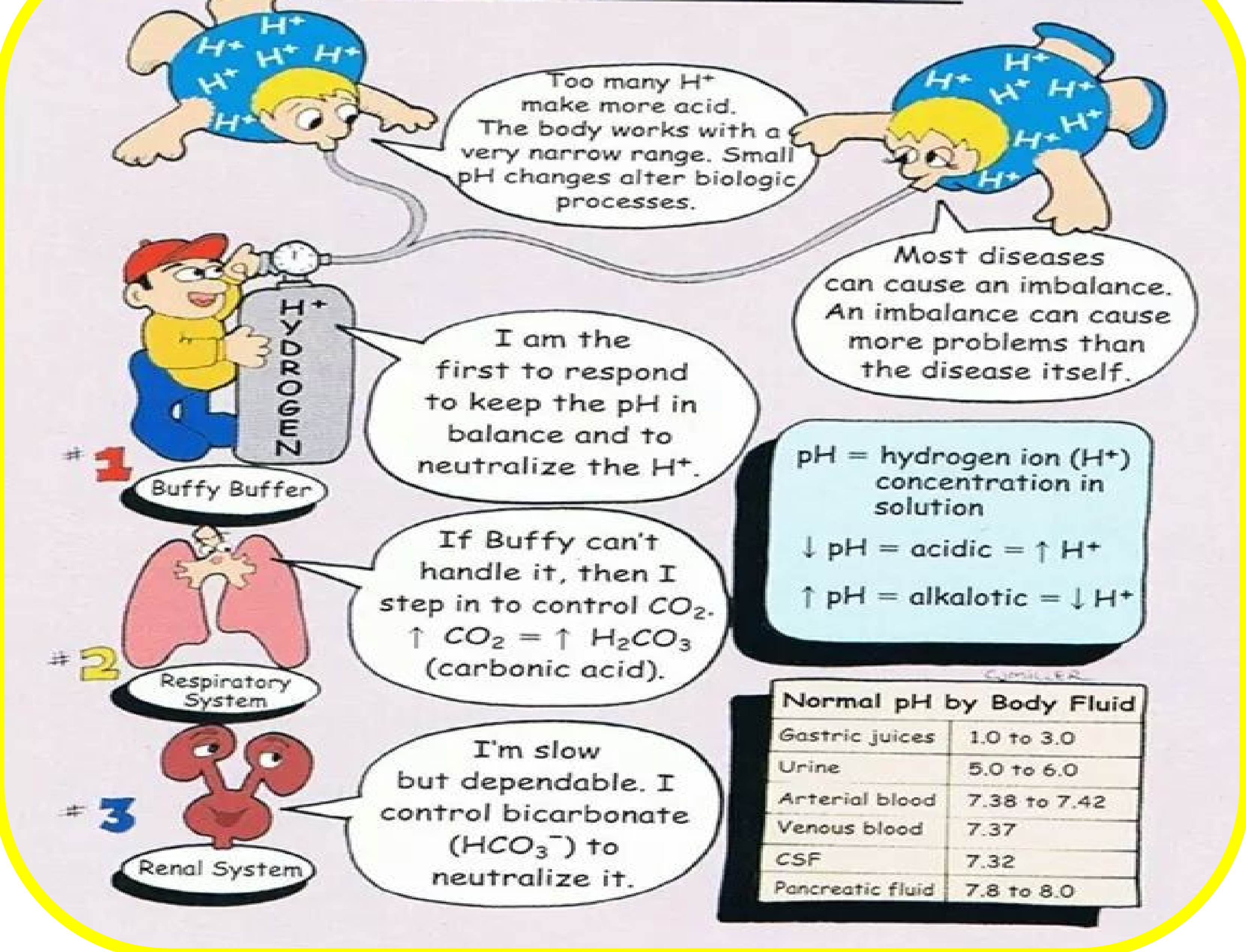
intermediate (12-24 hours).

3.Renal regulation of [H] and [H

occurs more slowly (several days) but

The most potent.

ACID-BASE BALANCE



Too many H⁺ make more acid. The body works with a very narrow range. Small pH changes alter biologic processes.

Most diseases can cause an imbalance. An imbalance can cause more problems than the disease itself.

I am the first to respond to keep the pH in balance and to neutralize the H⁺.

If Buffy can't handle it, then I step in to control CO_2. ↑ CO_2 = ↑ H_2CO_3 (carbonic acid).

I'm slow but dependable. I control bicarbonate (HCO_3^-) to neutralize it.

pH = hydrogen ion (H^+) concentration in solution

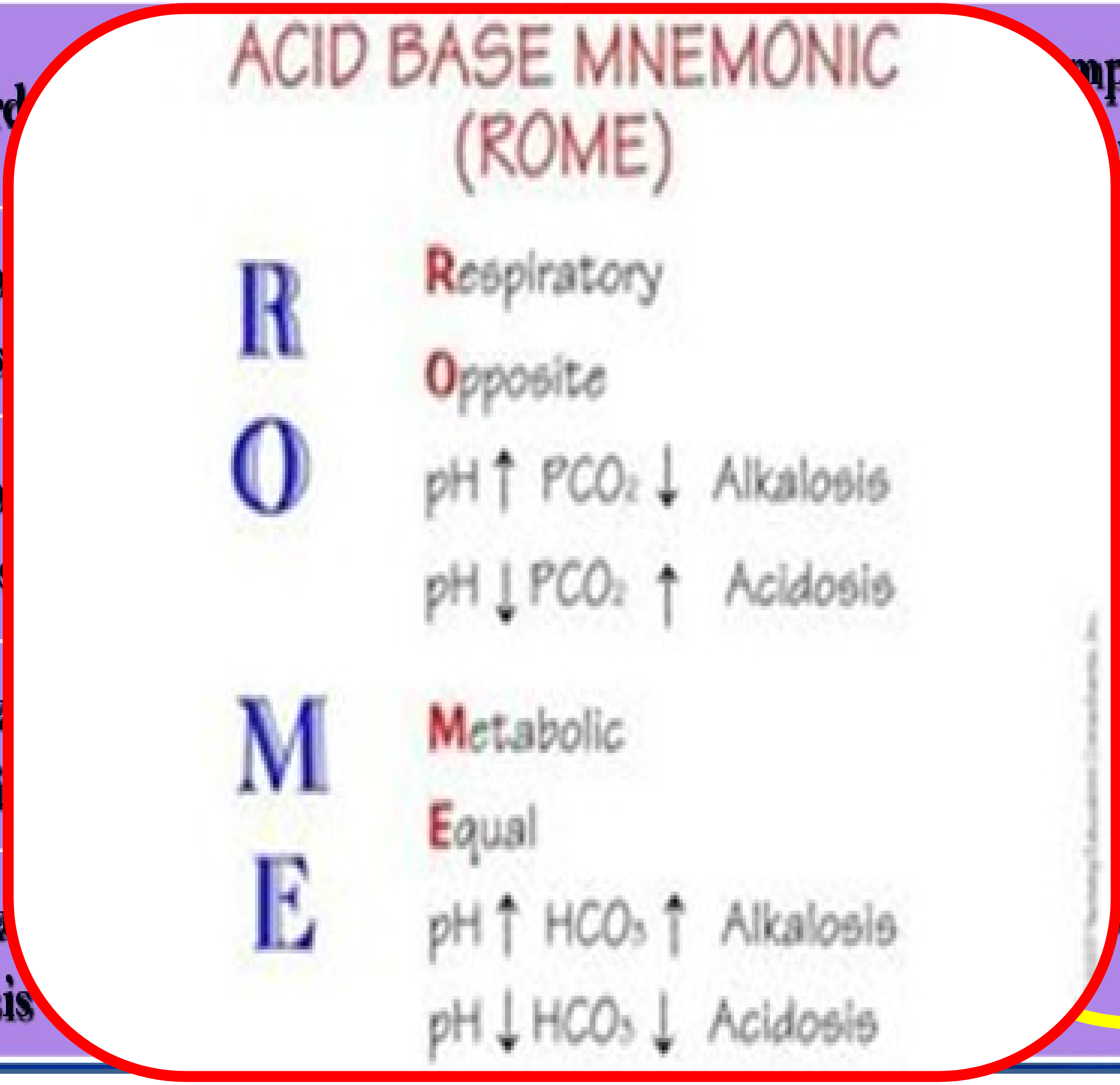
↓ pH = acidic = ↑ H^+

↑ pH = alkalotic = ↓ H^+

Normal pH by Body Fluid	
Gastric juices	1.0 to 3.0
Urine	5.0 to 6.0
Arterial blood	7.38 to 7.42
Venous blood	7.37
CSF	7.32
Pancreatic fluid	7.8 to 8.0

Compensated response:

Disord	mpensated nse
Metab acidos	Pco2
Metab alkalos	Pco2
Respira acidosi	ICO3-]
Respira alkalosis	ICO3-]



ACID BASE MNEMONIC (ROME)

R Respiratory

O Opposite

pH ↑ PCO_2 ↓ Alkalosis

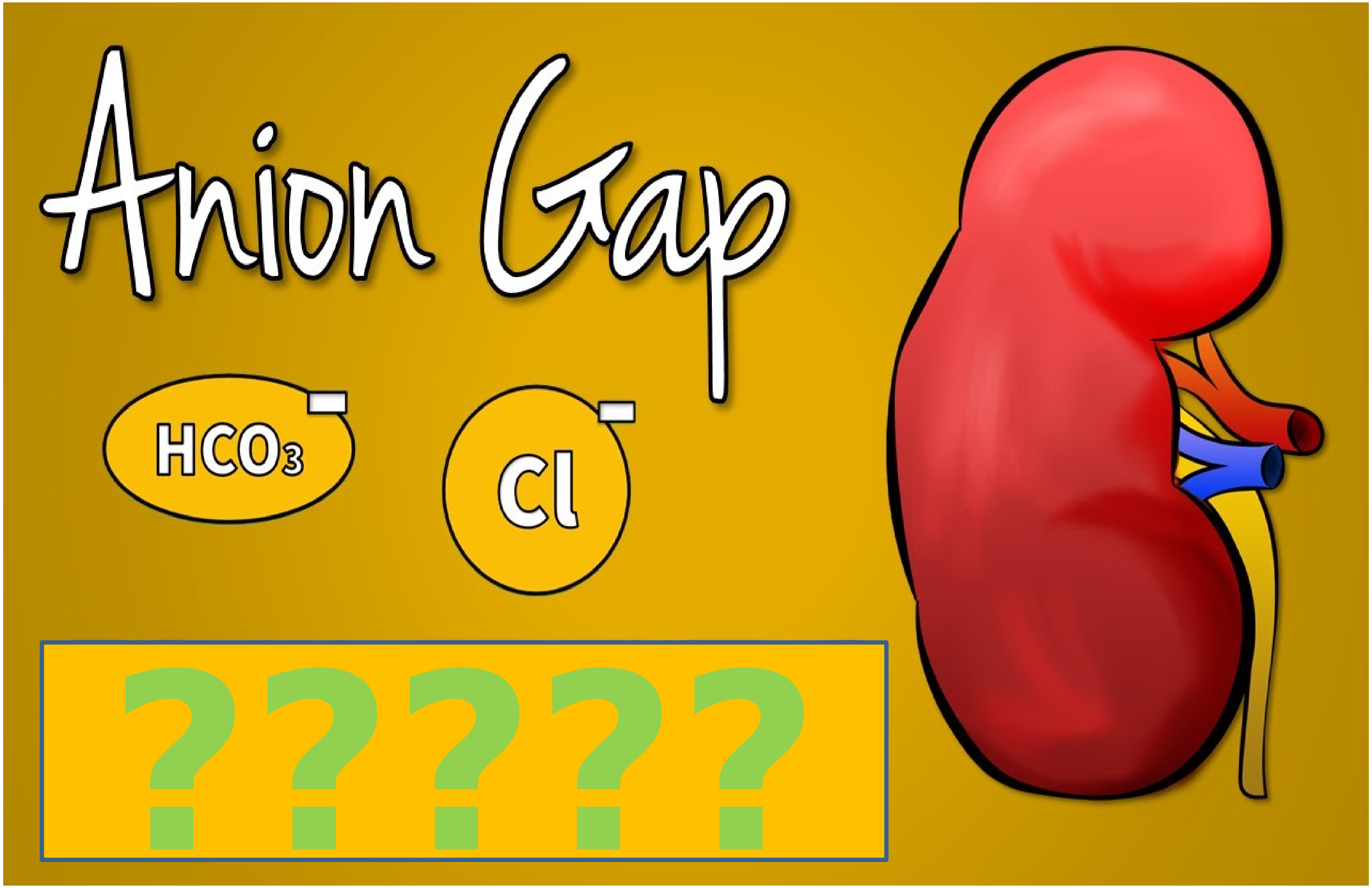
pH ↓ PCO_2 ↑ Acidosis

M Metabolic

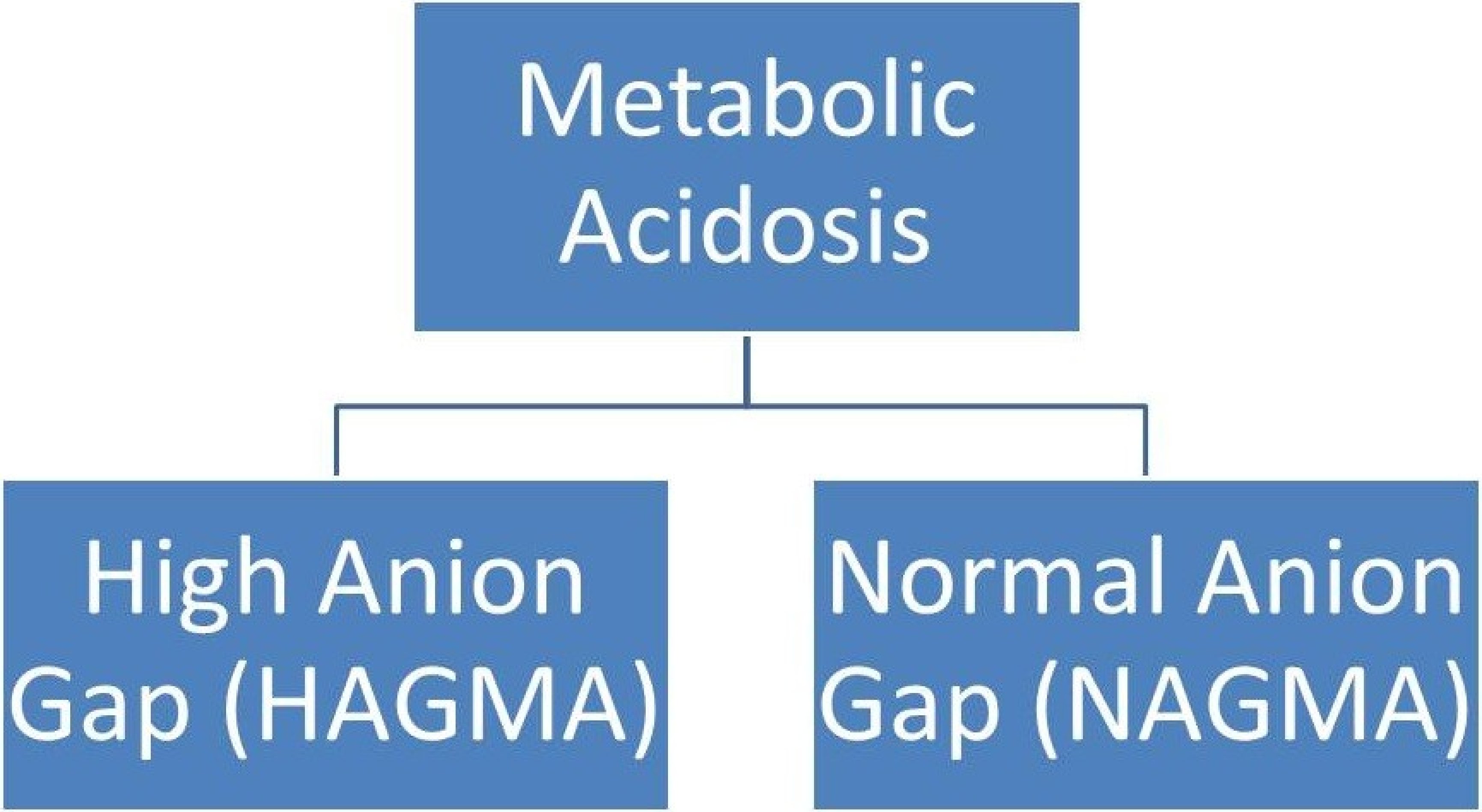
E Equal

pH ↑ HCO_3 ↑ Alkalosis

pH ↓ HCO_3 ↓ Acidosis


Anion Gap
HCO_3^-
Cl^-

?????

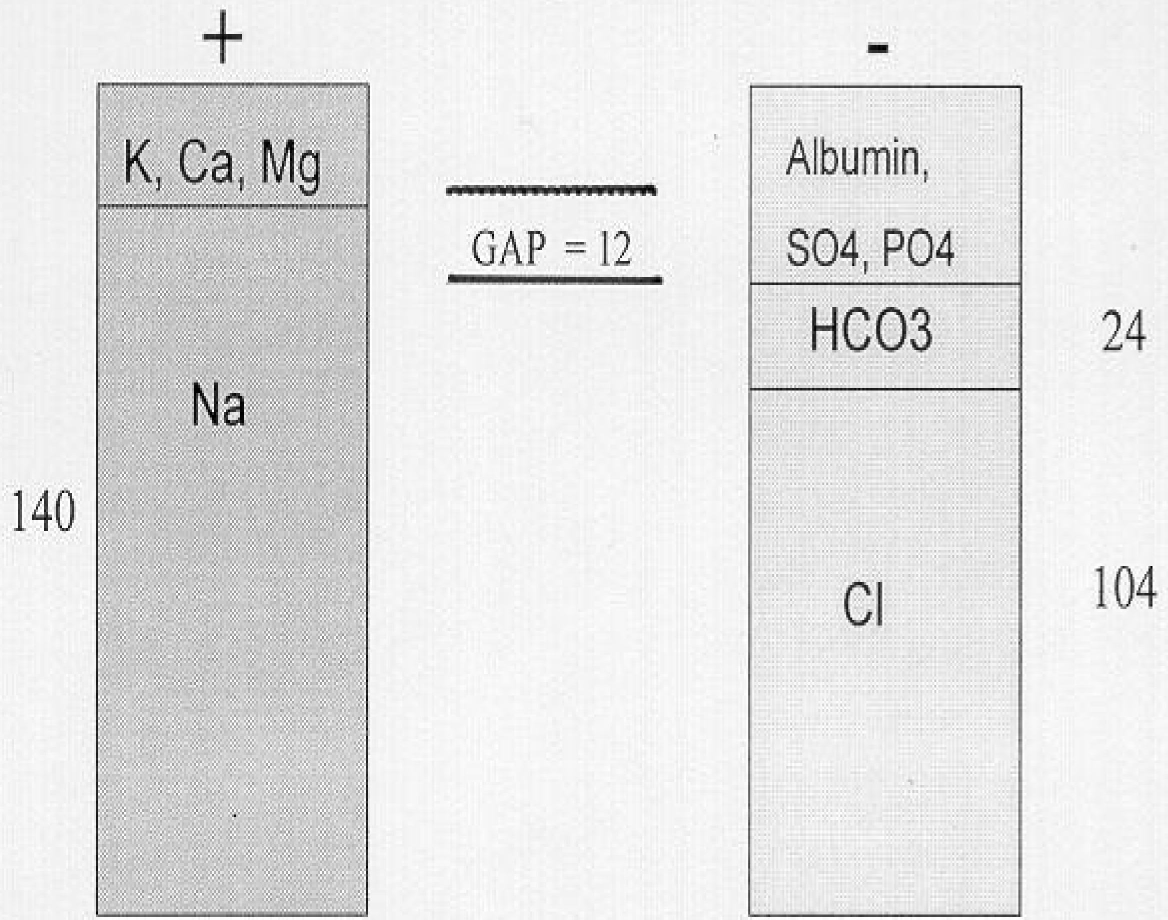


Metabolic Acidosis

High Anion Gap (HAGMA)

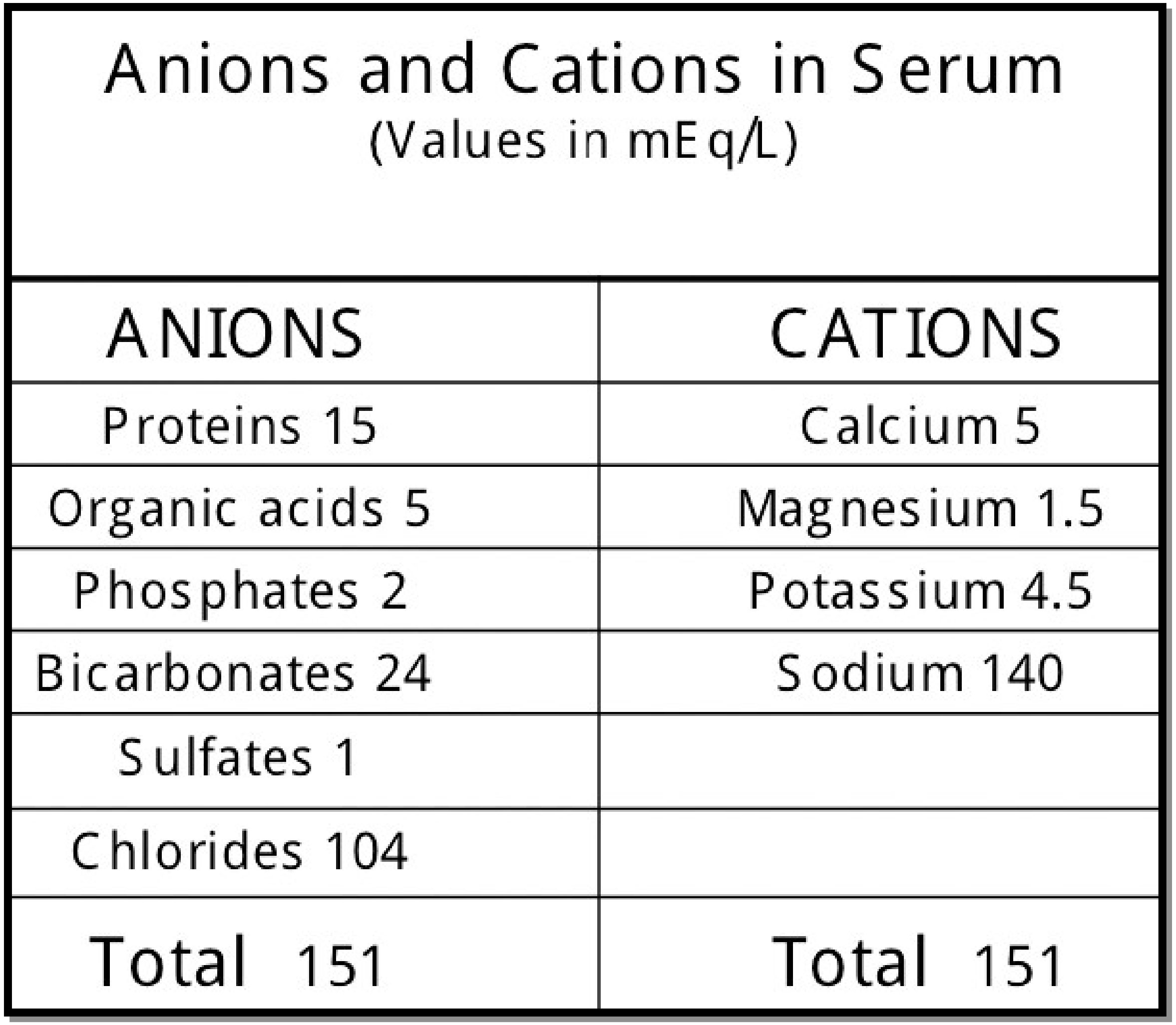
Normal Anion Gap (NAGMA)

Plasma Anion Gap
Na - (Cl + HCO3)



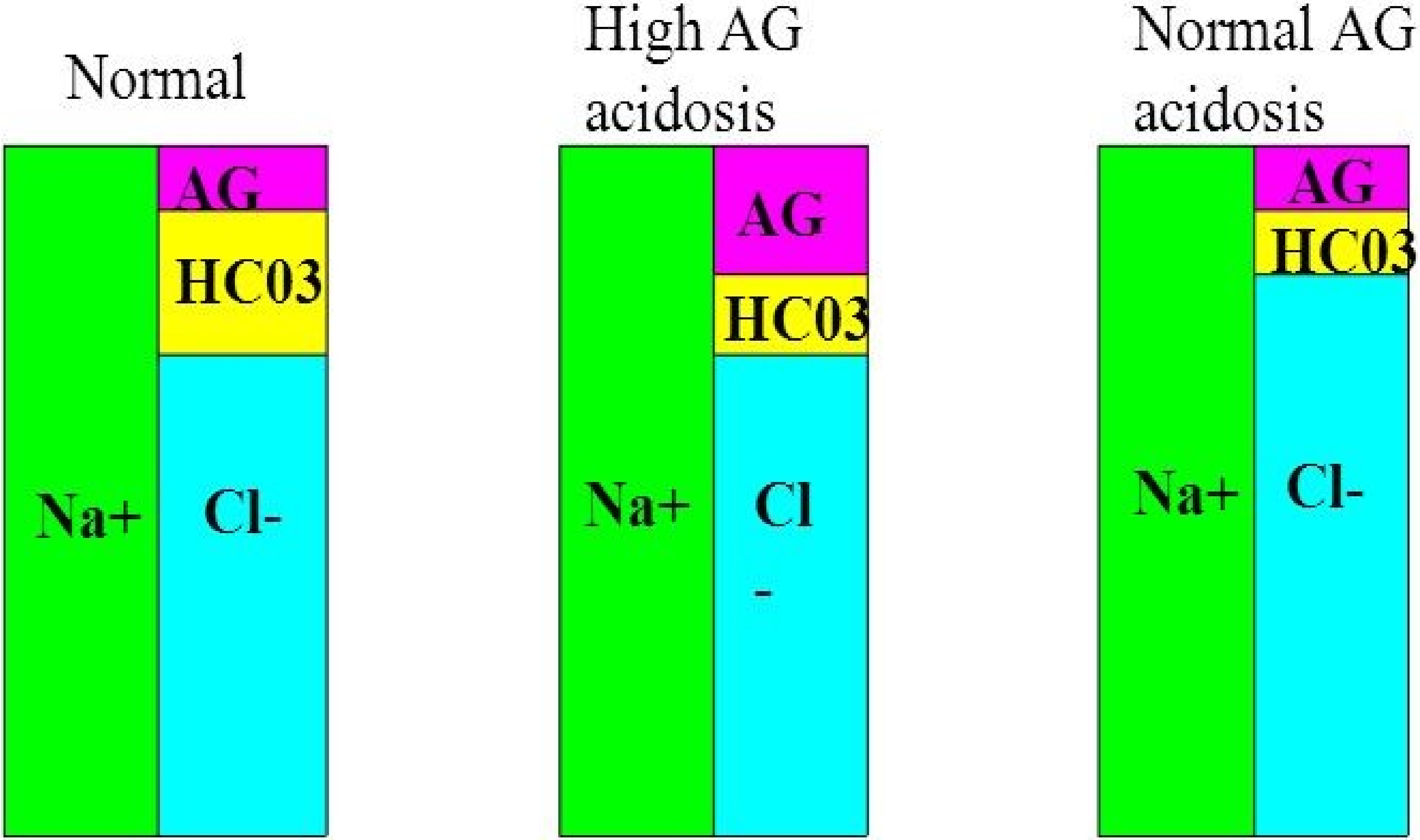
Actually there is no gap

[Na+] -([Cl-] + [HCO3-])



Anions and Cations in Serum
(Values in mEq/L)

ANIONS	CATIONS
Proteins 15	Calcium 5
Organic acids 5	Magnesium 1.5
Phosphates 2	Potassium 4.5
Bicarbonates 24	Sodium 140
Sulfates 1	
Chlorides 104	
Total 151	Total 151



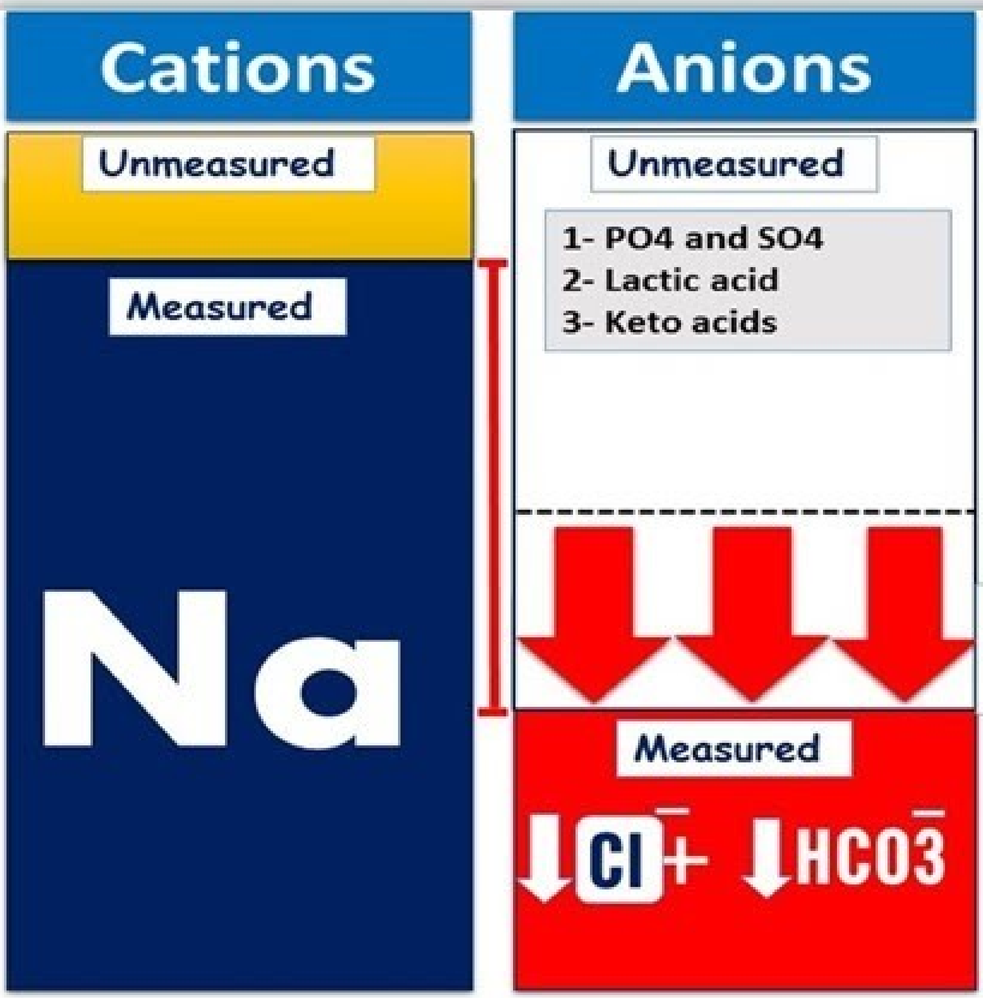
Normal

High AG acidosis

Normal AG acidosis

The anion gap

Anion Gap



Cations

Unmeasured

Measured

Na

Anions

Unmeasured

1- PO_4 and SO_4
2- Lactic acid
3- Keto acids

Measured

$\downarrow Cl^- + \downarrow HCO_3^-$

Anion Gap is increased in

Accumulation of Acids

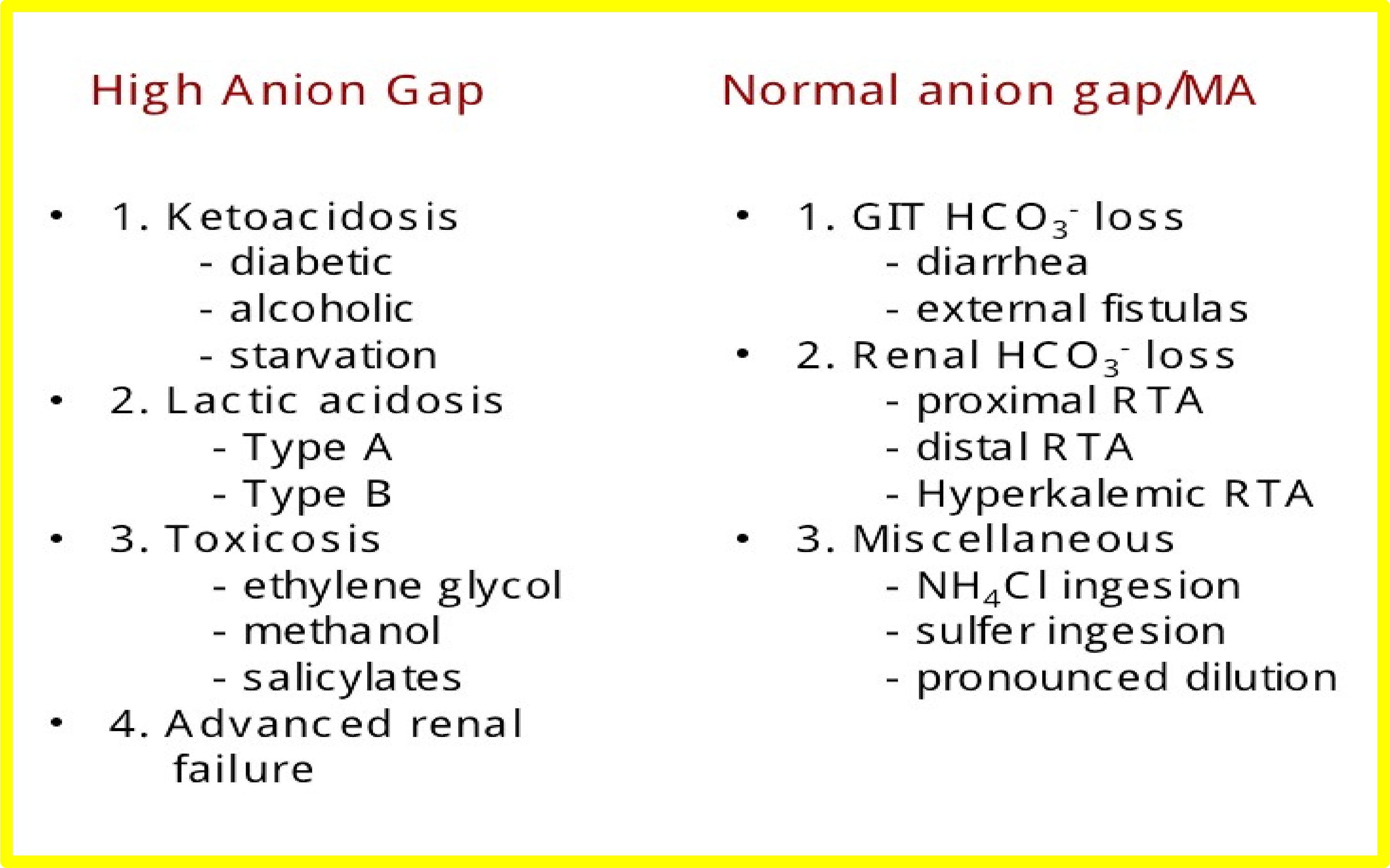
① *Renal Failure*
② *DKA*
③ *Lactic Acidosis*

And addition of acid such as

+++++ Salicylate
+++++ Methanol
+++++ Ethylene glycol

High Anion Gap Acidosis (*Hypocholremic*)

Causes of metabolic acidosis:



High Anion Gap

- 1. Ketoacidosis
  - diabetic
  - alcoholic
  - starvation
- 2. Lactic acidosis
  - Type A
  - Type B
- 3. Toxicosis
  - ethylene glycol
  - methanol
  - salicylates
- 4. Advanced renal failure

Normal anion gap/MA

- 1. GIT HCO_3^- loss
  - diarrhea
  - external fistulas
- 2. Renal HCO_3^- loss
  - proximal RTA
  - distal RTA
  - Hyperkalemic RTA
- 3. Miscellaneous
  - NH_4Cl ingesion
  - sulfer ingesion
  - pronounced dilution

STEPWISE APPROACH

- Step 1: Valid ABG ?
- Step 2: Acidosis or Alka
- Step 3: Metabolic OR Respiratory
  If respiratory, acute or chronic ?
- Step 4: Simple or mixed & Assess for compensation.
- Step 5: If metabolic acidosis—A.G.?

Metabolic Acidosis:

PaCO2 = **(1.5 X HCO3) + 8 ± 2**

Metabolic Alkalosis:

PaCO2 will increase **0.75 mmHg** per **1 meq/L** increase in HCO3 above 24

(0.7 x HCO3) + 24 ± 1.5

Respiratory Acidosis:

Acute:

HCO3 will increase 1 meq/L per 10 mmHg increase in PCO2 above 40

Expected [HCO3] = 24 +1 { (Actual pCO2-40) / 10 }

Chronic:

HCO3 will increase 4 meq/L per 10 mmHg increase in PCO2 above 40

Expected [HCO3] = 24 + 4 { (Actual pCO2 -40) / 10}

Respiratory Alkalosis:

Acute:

HCO3 will decrease **2 meq/L** per **10 mmHg** decrease in PaCO2

Expected HCO3= 24-2{(40-actual PCO2)/10}

Chronic :

HCO3 will decrease **4 meq/L** per **10 mmHg** decrease in PaCO2

Expected HCO3= 24-4 {(40-actual PCO2)/10

- **PH = 7.25**
- **PCO2 = 30**
- **HCO3 = 12**

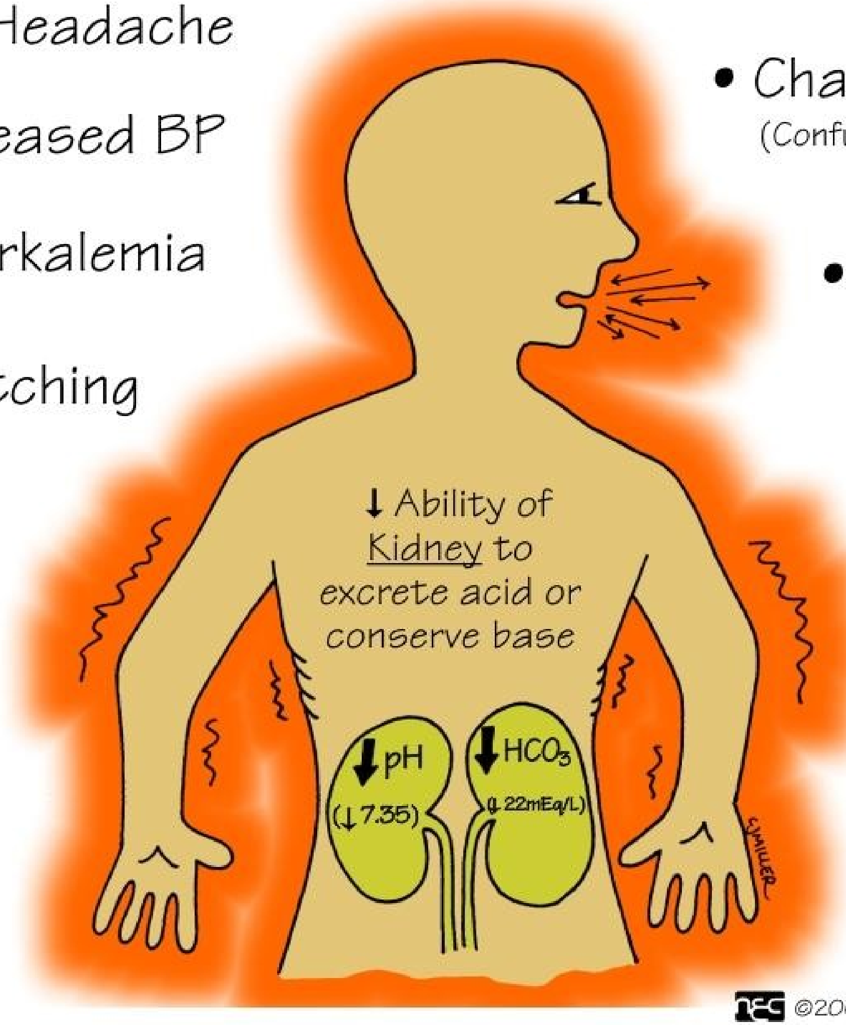
✓ **Validity**
✓ **Alkalosis or acidosis**
✓ **Metabolic or respiratory**
✓ **Simple or mixed**
✓ **Compensated or not**

①

Simple Metabolic ACIDOSIS

METABOLIC ACIDOSIS

- Headache
- Decreased BP
- Hyperkalemia
- Muscle Twitching
- Warm, Flushed Skin (Vasodilation)
- Nausea, Vomiting Diarrhea


↓ Ability of Kidney to excrete acid or conserve base
↓pH
(↓7.35)
↓HCO_3
(↓22mEq/L)
C.MILLER

- Changes in LOC (Confusion, ↑drowsiness)
- Kussmaul Respirations (Compensatory Hyperventilation)
- Causes:
  - DKA
  - Severe Diarrhea
  - Renal Failure
  - Shock

©2007 Nursing Education Consultants

- **HCO3 = 28**
- **PCO2 =60**
- **pH= 7.25**

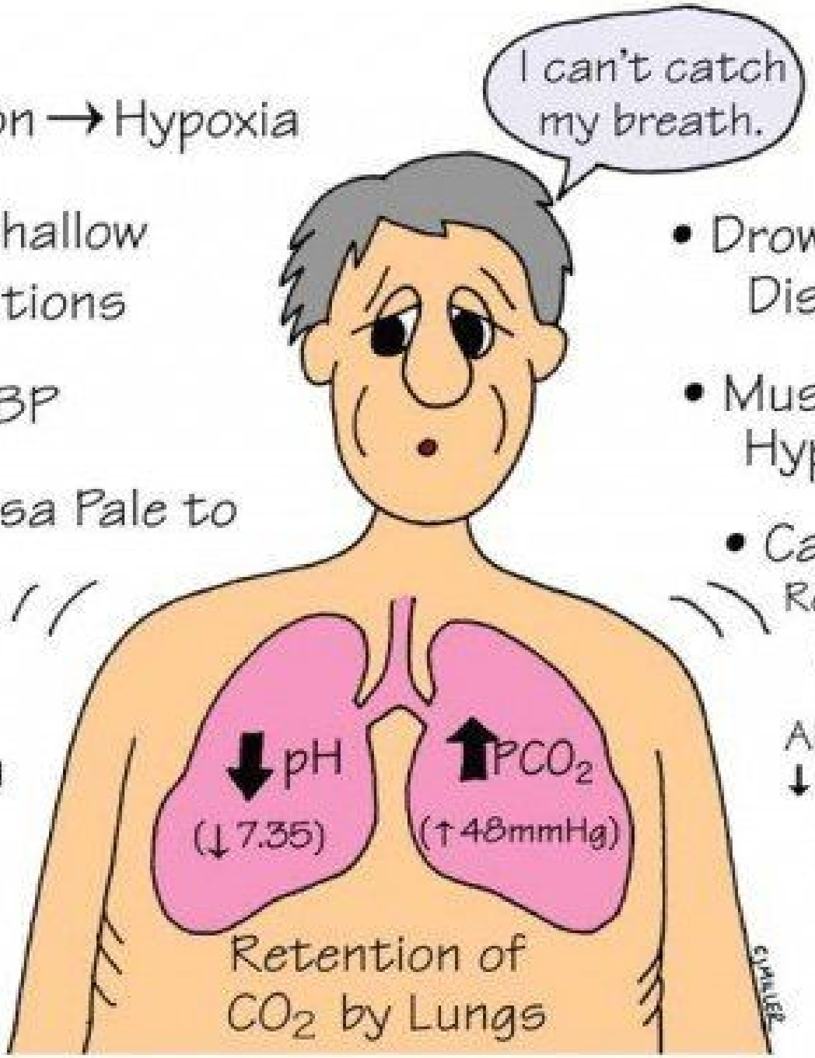
②

✓**Validity**
✓**Alkalosis or acidosis**
✓**Metabolic or respira**
✓**Simple or mixed**
✓**Compensated**

Simple
Respiratory
acidosis

RESPIRATORY ACIDOSIS

- Hypoventilation → Hypoxia
- Rapid, Shallow Respirations
- ↓ BP
- Skin/Mucosa Pale to Cyanotic
- Headache
- Hyperkalemia
- Dysrhythmias (↑K⁺)


I can't catch my breath.
↓pH
(↓7.35)
↑PCO₂
(↑48mmHg)
Retention of CO₂ by Lungs
C.MILLER

- Drowsiness, Dizziness, Disorientation
- Muscle Weakness, Hyperreflexia
- Causes:
  - Respiratory Depression (Anesthesia, Overdose, ↑ICP)
  - Airway Obstruction
  - ↓Alveolar Capillary Diffusion (Pneumonia, COPD, ARDS, PE)

NEC ©Nursing Education Consultants, Inc.

③

pH = 7.55

HCO3 = 19

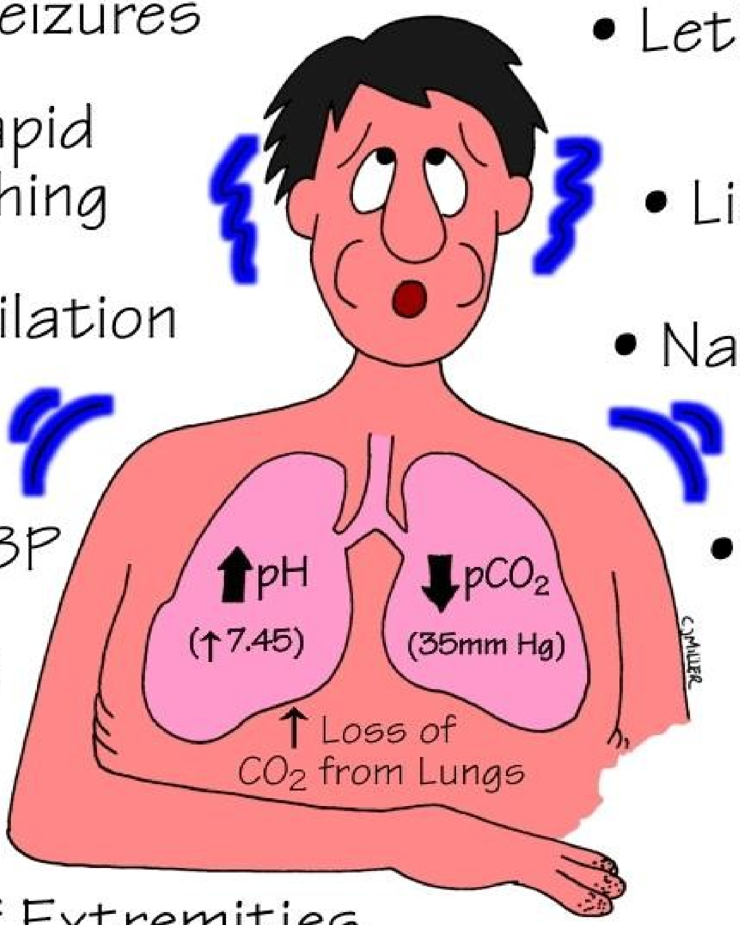
pCO2 = 20

Validity
Alkalosis or acidosis
Metabolic or respiratory
Simple or mixed
Compensated

SIMPLE
RESPIRATORY
ALKALOSIS

RESPIRATORY ALKALOSIS

- Seizures
- Deep, Rapid Breathing
- Hyperventilation
- Tachycardia
- ↓ or Normal BP
- Hypokalemia
- Numbness & Tingling of Extremities



- Lethargy & Confusion
- Light Headedness
- Nausea, Vomiting
- Causes:
  - Hyperventilation (Anxiety, PE, Fear)
  - Mechanical Ventilation

NEC ©2007 Nursing Education Consultants, I

④

- pH = 7.25 ↓
- HCO3 = 16 ↓ (16-24= 33%
- PCO2 = 60 ↑ (60-40=50%)

Determine the

The bigger %
1ry disorder

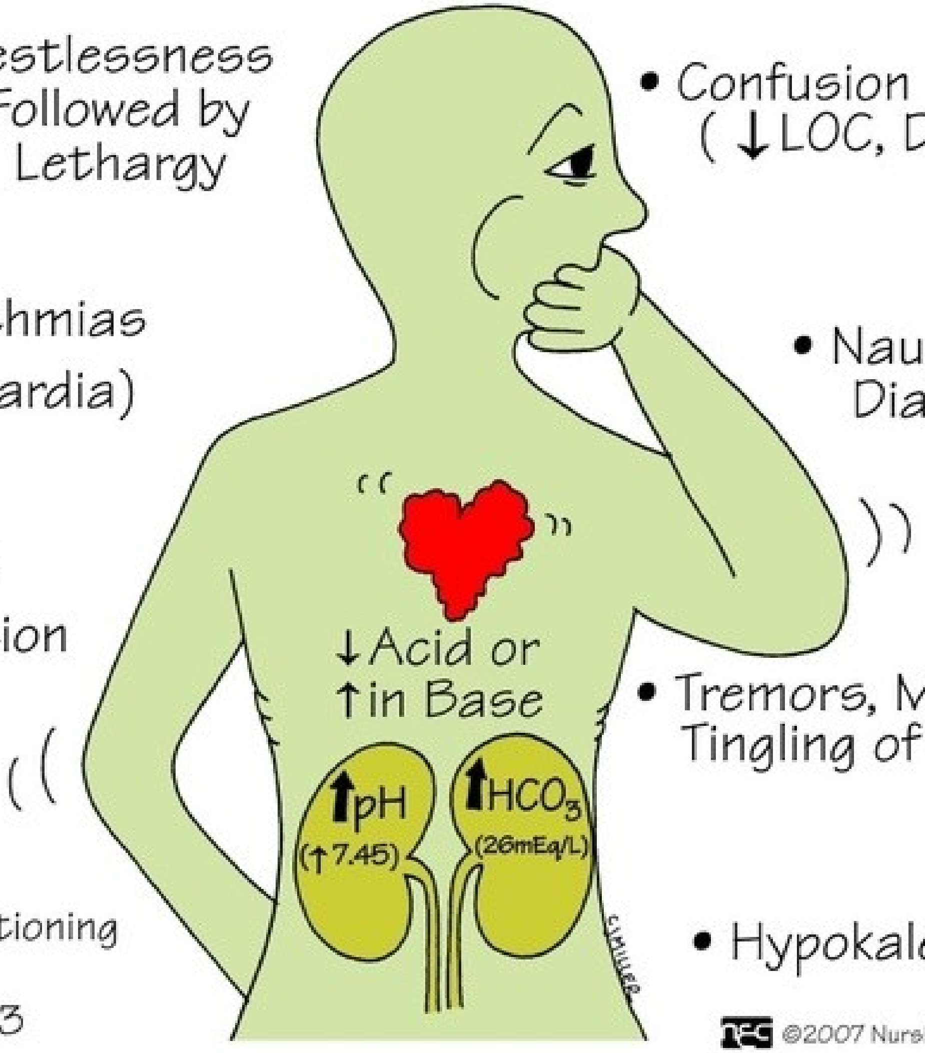
Mixed
respiratory
acidosis

⑤

- Ph=7.5 ↑
- HCO3= ↑8 (38-24= 58
- PCO2= ↓0
- The bigger %d
  the 1ry disord

*Mixed*Metabolic alkalosis

METABOLIC ALKALOSIS



- Restlessness Followed by Lethargy
- Confusion (↓LOC, Dizzy, Irritable)
- Dysrhythmias (Tachycardia)
- Nausea, Vomiting, Diarrhea
- Compensatory Hypoventilation
- Tremors, Muscle Cramps, Tingling of Fingers & Toes
- Causes:
  - *Severe Vomiting*
  - Excessive GI Suctioning
  - Diuretics
  - Excessive $NaHCO_3$
- Hypokalemia

NEC ©2007 Nursing Education Consultants

thank
you